

WHAT IS CLAIMED IS:

1. An operation-supporting apparatus for plant equipment, comprising:

an operation request input unit that inputs information relating to operation request items of the plant equipment;

an operating conditions setting unit that converts operation request input information, input by the operation request input unit, to operating parameters;

an operation history creation unit that creates an operation history by chronologically processing the operating parameters, converted by the operating conditions setting unit, based on input from an operation monitoring unit that monitors operating states of the plant equipment;

a breakdown statistics database that stores an event tree of the plant equipment in correlation with degrees of unreliability relating to breakdown events;

an event simulator that calculates the degree of unreliability corresponding to the operating parameters, based on the information in the breakdown statistics database, the operation request information, and the operation history information, and in compliance with the event tree of the plant equipment;

a risk-cost calculation unit that calculates risk-cost by determining the aggregate product of the degrees of unreliability and restoration costs in compliance with the event tree;

an operating method determination unit that determines whether operating conditions are suitable by comparing the risk-cost with profit that is expected to be gained by continuing operation; and

an operating method specification unit that specifies specific operation conditions for the plant equipment in accordance with the operating method determined by the operating method determination unit.

2. The operation-supporting apparatus for plant equipment according to Claim 1, wherein the operation monitoring unit includes detectors that detect all or some of the temperature and pressure of operational fluids of plant equipment, number of rotations of rotating parts, and output load, chronologically processes the detected signals, arranges regular and irregular operations into predetermined categories, and collects and stores data that relates to number of start-ups and operating times.

3. The operation-supporting apparatus for plant equipment according to Claim 1, wherein the breakdown statistics database uses an event tree, that is based on previous breakdown events in the plant and/or other similar plants and relates to cracks, deformation, erosion, abrasion, oxidation, corrosion, deterioration of materials, breakage, reduced capability, and functional deterioration, and a degree of unreliability function for each event, these being expressed as a function of material lifetime parameters in correspondence with operation conditions, or as a function of parameters of temperature, stress, warping, and environmental factors, that represent operating conditions.

4. The operation-supporting apparatus for plant equipment according to Claim 1, further comprising a breakdown monitoring unit that detects breakdown events while the plant equipment is operational and precursory breakdown events; and an emergency stop determination unit that determines whether to stop operation immediately based on a detection signal detected by the breakdown monitoring unit; and wherein,

when not immediately stopping operation, the probability of an event that already occurred in the event tree stored in the breakdown statistics database is corrected from a pre-event probability to a post-event

probability, and in addition, a subsequent event is corrected by using the post-event probability of the event that already occurred, and the event simulator uses a corrected degree of unreliability.

5. The operation-supporting apparatus for plant equipment according to Claim 4, wherein the breakdown monitoring unit detects all or some of member temperature, warping/displacement, vibration, lubricating oil temperature, changes in lubricating oil components, partial thermal efficiency, plant efficiency, operational fluid leaks, operation sound, and acoustic emission signals, of plant equipment, and sends information, that indicates whether a breakdown event or a precursory breakdown event has occurred, to the emergency stop determination unit and the breakdown statistics database.

6. The operation-supporting apparatus for plant equipment according to Claim 1, further comprising an inspection unit that inspects breakdown events and precursory breakdown events of equipment members while the plant equipment has stopped operating; and wherein

information relating to the occurrence of breakdown events and precursory breakdown events detected by the inspection unit is transmitted to the breakdown statistics database, a degree of unreliability function is corrected to post-event probability, and, in cases where the operating method determination unit determines that operation cannot restart and that operation is possible only under certain conditions, a repair method is selected, the degree of unreliability in the breakdown statistics database being changed when the repairs have been carried out, another simulation is executed and the operating method determination unit makes a determination.

7. The operation-supporting apparatus for plant

equipment according to Claim 6, wherein the inspection unit uses all or some of a CCD camera, an ultrasonic sensor, an electric resistance sensor, and an electromagnetism sensor, to measure all or some of cracks, warping/displacement, erosion, abrasion, oxidation, corrosion, and breakage, of plant equipment.

8. The operation-supporting apparatus for plant equipment according to Claim 1, further comprising a probability theory lifetime evaluation unit that calculates a lifetime evaluation by appending probabilities to lifetimes of plant equipment with respect to creeping and fatigue by using material lifetime characteristics, stored beforehand in a statistical material database, and the probability distribution thereof, based on operation history information and operation request input information that relates to the plant equipment,

a degree of unreliability function being calculated from the lifetime evaluation, determined by the probability theory lifetime evaluation unit, stored in the breakdown statistics database, and used in calculations made by the event simulator.

9. The operation-supporting apparatus for plant equipment according to Claim 8, further comprising a deterioration/damage measuring unit that calculates values for material deterioration and material damage of equipment members while the plant equipment has stopped operating,

statistical material data, that is required in the evaluation processing of the probability theory lifetime evaluation unit, being determined from the deterioration/damage measurements obtained from the deterioration/damage measuring unit.

10. The operation-supporting apparatus for plant

equipment according to Claim 9, wherein the deterioration/damage measuring unit uses all or some of a hardness measuring unit, an electromagnetism measuring unit, a sampling unit, a replica-collecting unit, and an electric resistance measuring unit, to measure softening, fragility, creep void, cracks, deformation, and warping, of equipment members.

11. The operation-supporting apparatus for plant equipment according to Claim 1, wherein information from a plurality of the operation monitoring units and the breakdown monitoring units, provided for respective plants, and information output from a plurality of the operating method determination units, provided for respective plants, are transmitted via a network.